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ABSTRACT

This module provides information on: (1) the origin of the oceans; (2) sources of minerals and salt found in the sea; and (3) the role and uses of salt in various cultures (stating, for example, that the expression "salt of the earth" describes a person who is considered one of the best). (JN)

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What We Take From Our Environment

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Science and Technology Education in Philippine Society

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The Story of the Oceans and Salt

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THE STORY OF THE OCEANS AND SALT

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The Story of Oceans and Salt

Earth scientists made a careful guess that about 71% of the earth's surface is covered with water. The earth is a watery planet. There is no other planet like it in the solar system. The water on earth forms oceans and seas.

EARTH MAP (Sinusoidal Projection)

How were the oceans and seas formed? Who first obtained salt from the seas?

People have often asked these questions.

This module will give some answers.

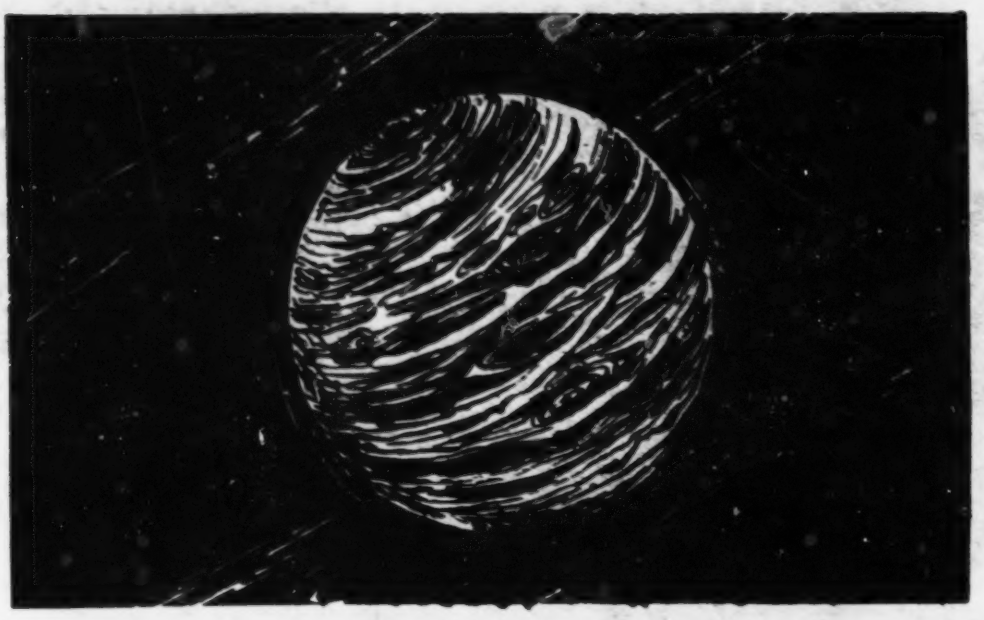
HOW THE OCEANS CAME TO BE

Bible history states that God created the sun, the earth and the other planets in one day. It was, however, not our usual day of 24 hours. God allowed nature to run its course; it took millions of years. Most astronomers believe the earth started to form from four to six billion years ago. No man was yet born to see its beginning. Many scientific guesses, however, have been made.

All particles of matter attract each other by gravitational forces. In darkness, dust and gas particles came together in space. Ninety percent (90%) of the original dust and gases formed a flat circular body, the future sun. The remaining 10% formed the future earth and the other planets of the solar system. The planets differed in the amount and kind of materials. Attracted by the bigger sun, these flat circular bodies moved round the sun (revolved) at different distances.

FLAT CIRCULAR BODIES MOVING ROUND THE SUN

More particles of dust and gases were attracted to each body. The particles of the different planets formed more dense[1] ball-like bodies. As the particles came closer together the attractive forces increased and heat was produced. The sun, the earth and the other planets started to get hot. The temperature and pressure inside them increased. They turned around their own axes (rotated).



THE EARTH TURNING AROUND ITS AXIS

The great temperature and pressure inside the sun caused hydrogen to change to helium. Great amounts of heat and light were given off.

Let us turn our attention to changes in our planet earth. Inside the earth, radioactive elements[2] changed to other elements and gave off a great amount of heat. The increased temperature caused other materials to melt and to react with each other. Steam and gases as hydrogen, nitrogen and methane; metals as iron, nickel and cobalt were set free. The gases escaped to form clouds surrounding the earth. The attractive force of gravity of the earth held this atmosphere of gases and steam around it.

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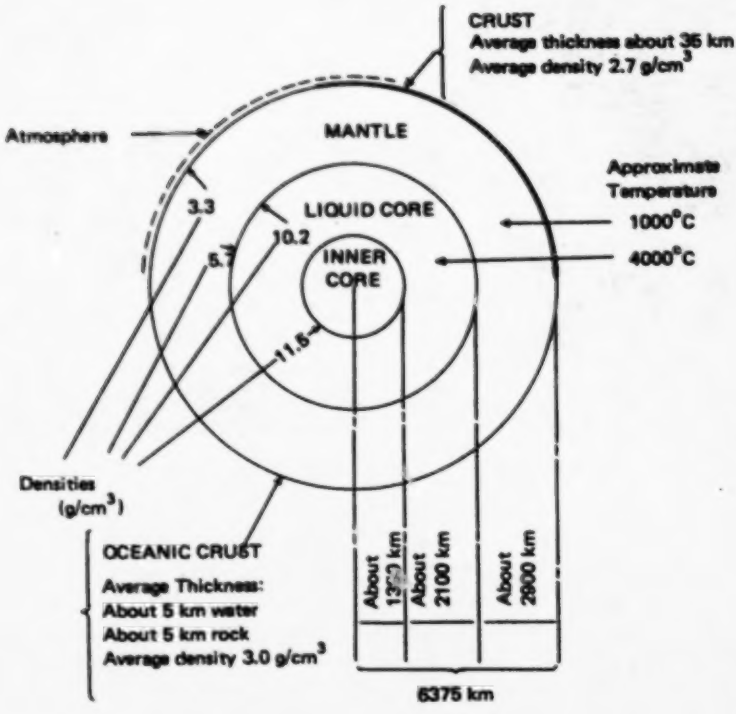
[1] *Density* is the mass of a milliliter or cm^3 of a material. Material A has the same volume as material B. If material A has a greater mass than B, we say A is more dense than B.

[2] Radioactive elements are elements that by themselves give off radiations from the nuclei of their atoms.

The outer portion of the earth gave off heat to space. The thin, less dense outer portion solidified to form the crust of the earth. The bottom, more dense part of the crust covered the earth all around. A scientist, Alfred Wegener, believed that this lower part of the crust formed the bottom of the oceans. For this reason this layer is called the **oceanic crust**. The upper layer of the crust formed a single large continent called Pangaea (the lands). Next to the crust, a thick layer formed called the **mantle**. The melted dense metals, iron, nickel and cobalt sank below the mantle to form the **core**. The core is believed to consist of a solid iron, nickel inner core and a thick outer core of iron and some less dense materials.

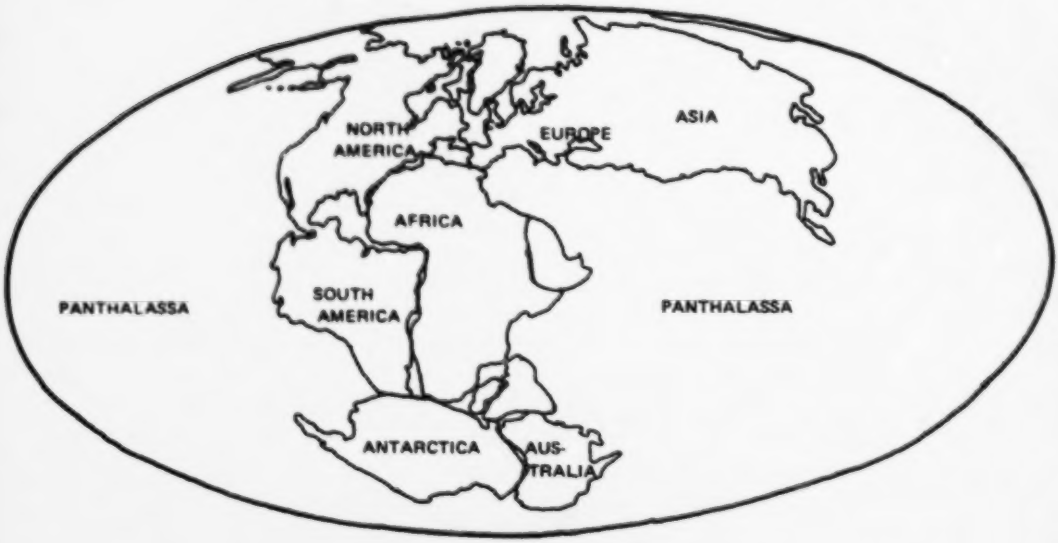


CONCENTRIC LAYERS OF THE EARTH

Water vapor in the clouds gave off heat to space. It cooled and turned into liquid (condensed). Liquid water as rain fell on the 1095°C hot crust and continent. All the water changed back to water vapor (evaporated). This cycle of condensation from gas to liquid and evaporation from liquid to gas went on for thousand of years.

In our science class we learned that when a liquid changes to gas it uses up heat. So the repeated evaporation of rain on the crust and continent removed heat. This resulted in the cooling of the surface of the earth. The thick clouds over the earth also helped in the cooling. They prevented the sun's rays from reaching the surface of the earth. Cooling of the earth's crust to below 100°C, the boiling temperature of water, took millions of years. Rain now began to fill the deep portions of the earth's surface to form the ocean. As there was only one continent, there was also only one big world ocean, the Panthalassa.

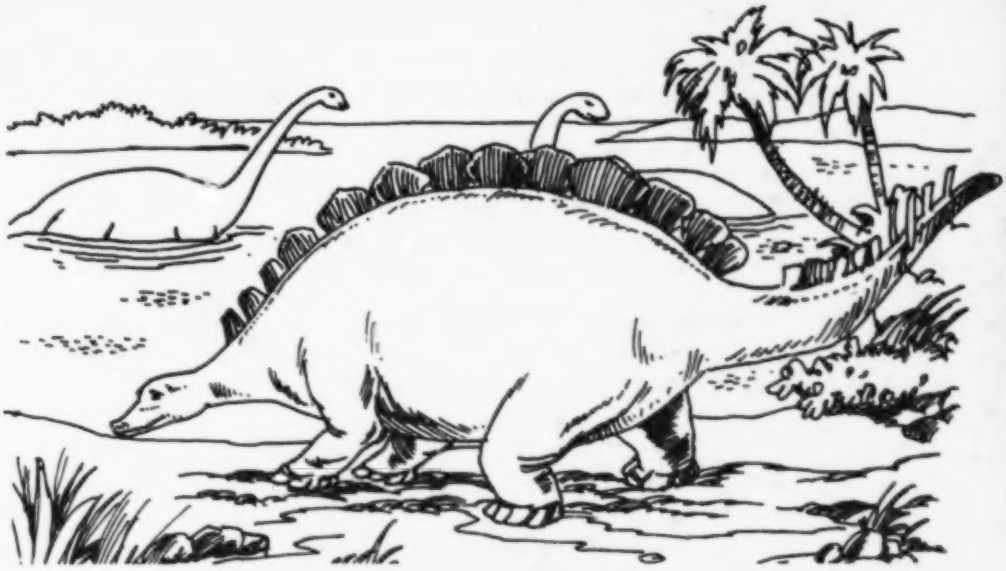
As water flowed over the continental rocks to the ocean, it reacted with the rock materials. Substances containing hydrogen, carbon, nitrogen and oxygen, and other materials dissolved from the rocks were carried to the ocean.



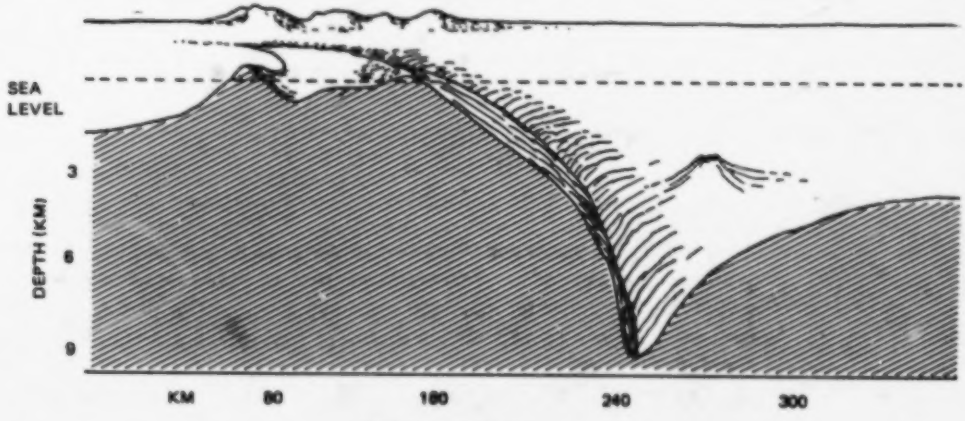
THE SINGLE PANTHALASSA SURROUNDED THE SINGLE PANGAEA (THE LAND)

Finally tiny plants and later larger ones started to grow in the ocean. Photosynthesis, the process by which green plants in the presence of sunlight change carbon dioxde and water into food and oxygen began. Our present atmosphere containing oxygen formed. With a supply of oxygen and plants as food, animal life also developed.

Carried to land by the tides, sea plants and animals changed to be able to live in their new surroundings. Land plants and animals began to inhabit the land.

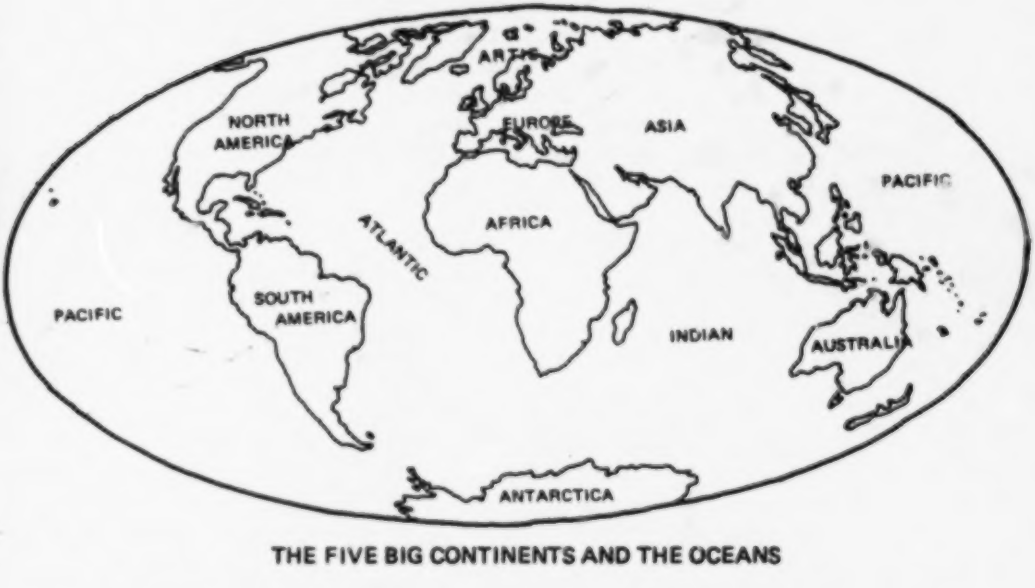


About 200 million years ago, with dinosaurs, large lizard like animals sometimes 27.5 meters high, already existing, the single continent started to break up. Ten big plates and many small ones were formed which moved in different directions relative to each other. Those that moved apart formed oceans between them. For example, the Atlantic Ocean between North and South America on one side and Eurasia and Africa on the other side. Some plates bumped into each other as India against Eurasia. This resulted in forming a long, deformed chain of mountains, the Himalayas. Sometimes when one plate bumped another, one edge of it went under the other plate. It sunk in the ocean to form a long narrow ditch or dugout (trench).



TONGA TRENCH

Five big continents were formed by the drifting plates, North and South Americas, Eurasia, Africa and Antartica. The continents can be thought of as big islands rising out of the world ocean. They divide the ocean into different parts, the Pacific, the Atlantic, the Indian and the Artic.



THE FIVE BIG CONTINENTS AND THE OCEANS

WHERE DO ALL THE MINERALS AND SALT IN THE SEA COME FROM?[3]

On land, winds and rain break down rocks and slowly wear away mountains. The naturally occurring substances (minerals) that are set free, dissolve in rain and river water. Rivers carry minerals to the seas and ocean. Every year the rivers add about 400 million tons of dissolved and suspended materials to the ocean.

Many of the dissolved minerals interact and settle on the ocean floor as insoluble solids. Sea creatures take in some of the dissolved minerals and these become part of their bodies.

Other sources of minerals are the rocks beneath the ocean; dead sea organisms that moved downward and settle at the bottom; shells from sea creatures; and other remains that do not decay. Rain wash gases and chemicals from the atmosphere; winds blow dust and dirt, underwater volcanoes erupt materials from their interior; tiny meteorites drop from outer space into the ocean.

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[3] See module *Potable Water from Sea Water by Solar Distillation (Part 1: Why is Seawater Salty?)* Project of the Science Education Center, University of the Philippines.

The volume of the ocean is very big compared to the total amount of minerals. Movement of ocean water quickly mixes the minerals. They are equally spread out all over the ocean. All the oceans and seas are only one big world ocean. So moving ocean water all over the world has the same average composition of dissolved minerals.

The total amount in grams of salts dissolved in 1000 grams of seawater is called its salinity. Salinity of ocean water varies from 33 to 37 grams of salt in 1000 grams of seawater. Average salinity of Manila Bay is 33.6 in May and 20.3 in September. Salinity at the Bataan Coast is 11.5 and 23 at other parts in September. Salinity in deep water is 34. At San Salvador, Iloilo, the average salinity of seawater is 33.4.

Table 1 gives the average salinity of seawater.

Table 1. SALTS IN ONE KILOGRAM OF SEAWATER

Salt	Formula	Mass in grams
sodium chloride	$NaCl$	27.21
magnesium chloride	$MgCl_2$	3.81
magnesium sulfate	$MgSO_4$	1.66
calcium sulfate	$CaSO_4$	1.26
potassium sulfate	K_2SO_4	0.86
calcium carbonate	$CaCO_3$	0.12
magnesium bromide	$MgBr_2$	0.08

Common table salt, sodium chloride (NaCl), is present in the largest amount in seawater.

THE STORY OF SALT

By whom and where was table salt first recovered from seawater? It is not known.

In Belgium, findings in caves showed men used salt in cooked foods five thousand years ago. Man also found salt can be used to preserve food. Early Egyptians used salt not only to preserve food but in embalming mixtures to preserve bodies of their dead.

The first written reference to salt, however, is found in the Book of Job, 300 years before the birth of Christ. "Can an unsavory[4] thing be eaten that is not seasoned with salt? " The Bible mentions salt more than 30 times.

[4] unsavory - tasteless

Salt once had a religious meaning. It was made a symbol of purity. It was a religious custom among the Hebrews to rub newborn babies with salt. They believed that this would keep the child in good health.

During the agricultural age, people worshipped the gods as the givers of the products of the earth. Cereals and salt were part of the sacrificial offerings to the gods. Greeks, Romans and a number of semitic people made agreements over a sacrificial meal and salt. The preservative qualities of salt made it a fitting symbol of a lasting and faithful compact. With the belief that salt was sacred, the idea originated that the devil hated and feared it. One abbot in the middle ages scattered salt in his church so that the devil would not bother the worshippers by making them sneeze or cough or sleep during his sermons.

Superstitious beliefs are associated with salt. Spilling salt brings bad luck. To keep off bad luck, a person must throw some salt over his left shoulder hoping to hit the devil in the eye and blind him.

A Norwegian and an English belief is that one will have to shed as many teardrops as needed to dissolve any salt one spills. Another belief is that one must wait outside the gate of heaven one year for every grain of salt one has spilled during his life.

Children in the orient used to wear small bags of salt around their necks to protect them from harm. Salt was used in weddings to bring good luck and in burials to protect the dead. A Russian superstition was that a newly married couple had to throw salt in all corners of their house to guard against evil. Here in our country, there is a belief that when one occupies a new house it is important to bring and keep a bottle full of salt to bring good luck.

In China, salt is burnt during the New Year celebration. If the salt burns brightly, it is an omen of good things in the coming year.

Long ago in America some unmarried girls practiced a ritual involving salt at Halloween. Hard boil an egg. Cut it open, remove the yolk and fill the cavity with salt. Exactly at midnight, eat all of it, without speaking to anyone or taking a drink of water. Go at once to bed. Before morning, in a dream, your future husband will appear with an offering of a drink of water.

An ancient English folk belief was that if a girl quarreled with her boyfriend and wanted the boy to come back to her, she had to do the following: On three successive nights throw a bit of salt into the fire reciting the following rhyme:

It is not this salt I wish to burn;
It is my lover's heart to turn;
May he neither rest nor happy to be
Until he comes and speaks to me.

The word *salt* gained the meaning of high appreciation and honor in ancient and modern language. Salt is still used as a sign of honor, friendship and hospitality. Arabs have a saying: "There is salt between us". This means, "We have eaten together and are friends". As a promise of loyalty, Bedouin tribesmen

place bread and salt in each other's mouths saying: "By this salt and bread, I will not betray thee".

A modern Persian phrase for disloyal or ungrateful is "naman haran". It means "untrue to salt".

You have often heard the English expression "salt of the earth". It is used to describe a person who is considered as one of the best.

Europeans introduced salt in some parts of the Western hemisphere and in India.

Salt was one of the chief economic products of the ancient world. The development of the old roads of commerce was due to the salt trade. Roman soldiers built the Via Salaria (salt route), one of the great military roads in history. Over this road, salt from Ostia was carried to Rome and other parts of Italy.

Herodotus tells of a caravan route that united the salt oases of the Libyan desert.

Ancient trade in salt and salted fish existed between the Aegean and the Black Sea coasts of Southern Russia. The salt was obtained by evaporation of seawater in natural ponds at the mouth of the Dnieper river. The supply of salt was once not equal to the demand. It became so valuable that it was used as money. Ethiopia, Africa and Tibet have used cakes of salt as money. In Central Africa, far from the sea, salt is a luxury; it is only used by the rich.

During the reign of Caesar, his soldiers received part of their pay as salt. This was known as the "salarium". From this word came the word "salary". The ancient custom of the "salarium" gave rise to the modern expression, "He is not worth his salt". This means, he does not deserve his wages.

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